Dust-Tolerant, High Pressure Oxygen Quick Disconnect for Advanced Spacesuit and Airlock Applications, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Future human missions to Mars, the Moon, Near-Earth Objects (NEOs) and other planetary bodies will require a spacesuit equipped with a compact, lightweight, reliable, dust tolerant, high pressure oxygen quick disconnect (QD) for astronaut extravehicular activity. The next generation of QDs must transfer high pressure oxygen (HPO2) between the vehicle and space suits under adverse conditions, including an extreme range of temperatures, in a high vacuum, and amid pervasive dust. Currently, no QDs deliver O2 at sufficient pressure, nor are they able to mate in the presence of dust. Honeybee Robotics proposes to develop a dust tolerant, high pressure oxygen quick disconnect suitable for advanced spacesuit and airlock applications. This system will integrate form, fit, and function of existing and new subsystems for umbilical quick disconnects, leveraging both the design work completed to-date by Oceaneering (provided by NASA) and the dust-tolerant QD connector prototypes that Honeybee developed to TRL 6 for spacesuit applications for NASA's Constellation program. These QDs have been successfully tested at 6x10-6 mbar coated in JSC-1AF lunar dust simulant. Materials integral to the dust-tolerant system can perform acceptably at -160°C. The Phase 1 effort will focus on modifications necessary to apply existing dust-tolerant electrical connection technology (US Patent No. 8,011,941) to high-pressure oxygen delivery. This will include developing and performance testing a model in the presence of significant amounts of JSC-1A lunar simulant. A successful end point will demonstrate the design's capability to transmit gas over the interface and prevent dust from entering the gas stream over multiple mate/de-mate cycles. A design path will be laid out for Phase 2 to address remaining technical challenges and create higher-fidelity hardware suitable for testing at NASA.

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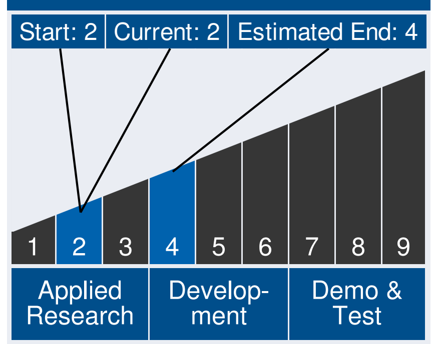
Technology Maturity



Management Team

Program Executives:
- Joseph Grant
- Laguduva Kubendran

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ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Dust tolerant, high pressure oxygen quick disconnects will be critical to future exploration missions beyond LEO. Such an interface will find extensive applications in EVA systems designed to operate on the surface of Mars, the Moon, or in the particulate torus around planetary moons and near-Earth objects. The dust-tolerant, high pressure oxygen quick disconnect commercial applications may include resource prospecting and long-term human settlement. The same interface used in an oxygen quick disconnect can also be used for other fluid transfers in dusty environments, including potable or cooling water, or waste CO2, for extended EVA operations. The dust tolerant QD can also be used for fuel; rovers or other vehicles that require liquid recharge of consumables, as would be the case with fuel cell-powered systems, will require a dust-tolerant fueling QD interface. This interface could be integrated into manual or autonomous recharge systems.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Future commercial space missions into LEO or beyond will require life support equipment for all travelers, and requirements for an oxygen quick disconnect interface will likely be similar to NASA standards. Currently, no commercial dust tolerant, high pressure oxygen quick disconnect system exists, and development of this technology will be attractive to commercial entities that need high-reliability life support systems for crewed missions. This includes any lunar exploration or settlements that seek to harvest resources from the moon. Beyond direct interfacing with primary life support systems for human exploration, a dust tolerant, cryogenic fluid repeatable mate/de-mate interface could find use in fuel transfer for planetary vehicles. Rovers, whether autonomous or for human transport, may require refueling to

Management Team *(cont.)*

Program Manager:

- Carlos Torrez

Principal Investigator:

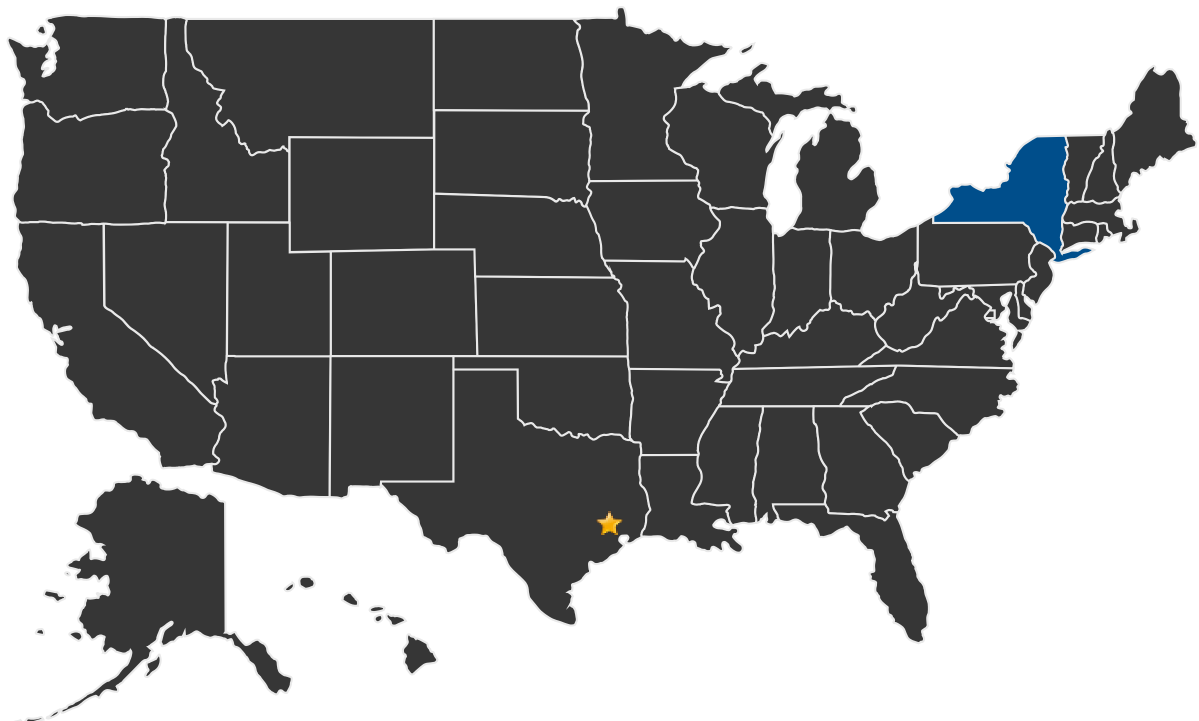
- Jason Herman

Technology Areas

Primary Technology Area:
Human Health, Life Support, and Habitation Systems (TA 6)
└─ Extravehicular Activity Systems (TA 6.2)
  └─ Portable Life Support System (TA 6.2.2)

recharge consumables, such as in the case of fuel cell-powered vehicles. Finally, autonomous spacecraft may require a dust tolerant interface to transfer fluid such as fuel, coolant, or other cryogenic fluids during on-orbit docking. This type of mating will likely be required for future modular spacecraft that are assembled on-orbit.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Johnson Space Center

Other Organizations Performing Work:

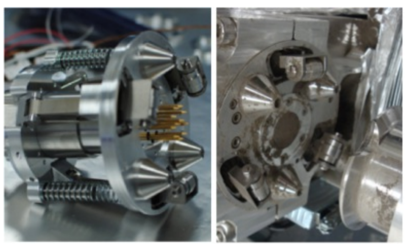
- Honeybee Robotics, Ltd. (New York, NY)

PROJECT LIBRARY

Presentations

- Briefing Chart
    - (http://techport.nasa.gov:80/file/23527)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

Dust-Tolerant, High Pressure Oxygen Quick Disconnect for Advanced Spacesuit and Airlock Applications, Phase I

Potential Applications

Dust tolerant, high pressure oxygen quick disconnects will be critical to future exploration missions beyond LEO. Such an interface will find extensive applications in EVA systems designed to operate on the surface of Mars, the Moon, or in the particulate torus around planetary moons and near-Earth objects. The dust-tolerant, high pressure oxygen quick disconnect commercial applications may include resource prospecting and long-term human settlement. The same interface used in an oxygen quick disconnect can also be used for other fluid transfers in dusty environments, including potable or cooling water, or waste CO2, for extended EVA operations. The dust tolerant QD can also be used for fuel; rovers or other vehicles that require liquid recharge of consumables, as would be the case with fuel cell-powered systems, will require a dust-tolerant fueling QD interface. This interface could be integrated into manual or autonomous recharge systems.